

| | | |
|---|---|---|
| FORM PTO-1390 (REV 11-2000) | U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE | ATTORNEY'S DOCKET NUMBER 3573-14 |
| TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371 | | U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) 10/049848 unknown |
| INTERNATIONAL APPLICATION NO. PCT/IB00/01088 ✓ | INTERNATIONAL FILING DATE 03/08/2000 ✓ | PRIORITY DATE CLAIMED 19/08/1999 ✓ |

TITLE OF INVENTION

ADD-ON RADIO REPEATER FOR TDMA POINT-MULTIPOINT RADIO COMMUNICATIN SYSTEMS ✓

APPLICANT(S) FOR DO/EO/US

NASCIMBENE, Andrea ✓

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The U.S. has been elected by the expiration of 19 months from the priority date (Article 31).
5. A copy of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☐ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has **NOT** expired.
 - d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 To 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included.
13. ☐ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information. PTO Form 1449

ADD-ON RADIO REPEATER FOR TDMA POINT-MULTIPOINT RADIO COMMUNICATION SYSTEMS

= * = * = *

This invention relates to a new way of providing add-on repeater in TDMA point-multipoint radio systems, allocating the functions to already existing components of these systems.

PRIOR ART AND RELATED PROBLEMS

It is well known that, when dealing with connections between two radio devices working at high frequencies (> 10 GHz), a Line-Of-Sight (LOS) condition is needed between the two antennas. Unfortunately (especially within the urban environment) this condition might be difficult to be provided for all sites.

Problems may be even bigger with point-to-multipoint (PMP) systems, as the one represented in Fig. 1 of the annexed drawings by way of example, where a radio base station (RBS) of a network (N) is initially connected to a number of radio access terminals (RAT) in a specific area. When subsequently one wants to add as many new terminals (RAT) as needed to connect new users to the network, even when worked according to an accurate planning, situations may arise in which providing new connections could be impossible, since the possibility of providing a line of sight condition is not available (e.g. due to the presence of buildings or to the pattern of the land) or no longer available (e.g. because new buildings have been built), or because errors in the previous planning of covering the interested area have been done, or because the same area was not of interest.

In such a case - which is represented in Fig. 2 - an area which is not covered by the radio base station (RBS) is referred to as "shadowed area" (therefore, it is represented shadowed in figure) and radio access terminals (RAT) which are desired to be installed in such an area are referred to as shadowed radio access terminals (SRAT).

Up to now, two solutions to the above referenced problem have been considered and both of them are unsatisfactory:

- to over-provision the access network, so that areas with expected coverage problems are served by more than one RBS;
- to move the RBS to a different site.

The first solution involves, of course, higher costs per access point and it anyway does not guarantee that adding new radio access terminals (RAT) will be

possible (for instance due to the possibility of new buildings, not existing upon the planning of the coverage).

Also the second solution is unsatisfactory: in fact, to move the radio base station (RBS) to a different site is difficult, as all antennas have to be re-aligned and all of radio access terminals (RAT) have consequently to be put out of working before their relocation.

SUMMARY OF THE INVENTION

Therefore, the main object of this invention is to provide a more simple and effective solution to the above problems, by means of a so called "radio access terminal/add-on radio repeater" (RAT/AR) which ensures an easy and fast arrangement, while leaving the already existing arrangement unchanged.

The repeater functionality is of course not new: indeed it is very largely used in the world. Nevertheless, the new idea is to have an ordinary Radio Access Terminal (RAT) that might be used as a repeater with a very low effort and without impacting the existing access network, so as to be able to reach other terminals in "shadow areas".

More in depth, the invention refers to an add-on radio repeater (RAT/AR) for TDMA point-multipoint radio communication systems, characterised in that it consists of an ordinary radio access terminal (RAT), to which the functionality of a repeater is given upon request.

Suitably, the functionality of a repeater is given to the said ordinary radio access terminal pre-existing and pre-installed in the network by adding an external unit, which comprises a new antenna and suitable co-ordination means. Said external unit does not affect the radio access terminal (RAT) and can be removed in any time.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is now described more in detail in the following, with reference to the annexed drawings, wherein:

Fig. 1 schematically shows a conventional point-multipoint TDMA radio communication system, of the above referenced kind;

Fig. 2 schematically explains the problem of enlarging a conventional point-multipoint TDMA radio communication system, such as the one of Fig. 1, also to which reference has been made above; and

Fig. 3 schematically shows a point-multipoint TDMA radio communication system according to this invention, wherein an add-on repeater is used, which

consists of a radio access terminal (RAT) to which the functionality of a repeater is given.

The invention applies to TDMA access networks, namely to networks which are based on time division multiple access. With such a kind of network, the radio base station (RBS) continuously transmits in the direction from itself to radio access terminal (RAT) (downlink direction), while in the opposite direction (from RAT to RBS, uplink direction) radio access terminals (RAT) send information only when they are allowed to do that, based on a pre-defined algorithm or on an explicit permits. The Media Access Control function (MAC) inside RAT determines whether the terminal is allowed to transmit. Conversely, in FDMA and CDMA networks, all transmitters are, or may be, constantly on.

The add-on radio repeater RAT/AR according to the invention basically consists of an ordinary RAT 1 (Fig. 3) also comprising a modem 5. When the repeater functionality is needed, an external unit 2 with a new antenna 3 is added thereto together with appropriate combining or co-ordination functions 4. This unit may be later removed in case the repeater function of the terminal is not needed any more (for instance because new RBS have been installed, covering the shadow area). The other parts components of the RAT 1 are not affected for these modifications, thus minimising implementation and installation complexity and making it possible to reuse the terminal 1 as an ordinary one, whereas it is not required thereto to play the role of a repeater.

The add-on repeater (RAT/AR) behaves towards the RAT's in the Shadow Area (SRAT) as if it were the RBS:

- in the downlink direction, the added-on transmitter continuously transmits the same information received from the RBS, without any change;
- in the uplink direction, data coming from SRAT are forwarded to the RBS, still without changes;
- since SRAT consider themselves as directly connected to the RBS, the ordinary TDMA access mode is used to prevent collision (algorithm or permit).

The approach used by this invention involves neither the possible modem 5, nor the MAC functions of the RAT 1 to which the repeater functionality has been added: the rest of the RAT/AR equipment of Fig. 3 simply acts as the terminal 1 did before. In other words, the repeater functionality is completely transparent to the equipment of the terminal 1 and especially to the MAC that has

not to manage any special protocol to allow RAT in the shadow area to communicate with the RBS.

The invention allows to achieve important improvements and a number of benefits, like:

- 5 - to achieve a higher degree of functionality -from RAT to RAT/AR - of the ordinary radio access terminals more easily;
- operators do not need to make reference to very expensive and detailed high-resolution maps in order to plan their network;
- possible unreliable coverage predictions can be corrected through RAT/AR
- 10 devices;
- future proof system deployment, even in case new buildings are erected;
- the line-of-sight problem can be considered as solved to a percentage very close to 100%;
- operators may increase their business, since virtually all customers are
- 15 reachable;
- operators will avoid promotion and negotiation activity with unreachable customers and/or any image drop when contracts already signed cannot be respected, thus increasing the system marketing value.

It is understood that other embodiments and/or modifications of the add-on

20 radio repeater (RAT/AR) are possible, still in the scope of the present invention.

ARTICLE 19 AMBT

M 15.03.01

CLAIMS

1. Add-on radio repeater (RAT/AR) for TDMA point-multipoint radio communication systems for fixed services (FS) and fixed wireless access applications (FWAA), characterised in that it consists of an ordinary radio access terminal (RAT), to which the functionality of a repeater is given upon request.

2. Add-on radio repeater (RAT/AR) as claimed in claim 1., wherein the functionality of a repeater is given to the said ordinary, pre-existing and pre-installed radio access terminal by means of adding an external unit, comprising a new antenna and suitable co-ordination means.

3. Repeater as claimed in claim 2., wherein the said external unit does not affect the radio access terminal (RAT) and can be removed at any time.

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
1 March 2001 (01.03.2001)

PCT

(10) International Publication Number
WO 01/15341 A1

(51) International Patent Classification⁷: **H04B 7/26**,
H04Q 7/32, 7/36

(21) International Application Number: PCT/IB00/01088

(22) International Filing Date: 3 August 2000 (03.08.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
99830526.2 19 August 1999 (19.08.1999) EP

(71) Applicant (for all designated States except US): TELEFONAKTIEBOLAGET LM ERICSSON [SE/SE];
S-126 25 Stockholm (SE).

(72) Inventor; and

(75) Inventor/Applicant (for US only): NASCIMBENE, Andrea [IT/IT]; Via S. Sofia, I-27020 Torre d'Isola (IT).

(74) Agents: VATTI, Paolo et al.; Fumero Studio Consulenza Brevetti, Via S. Agnese, 12, I-20123 Milan (IT).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

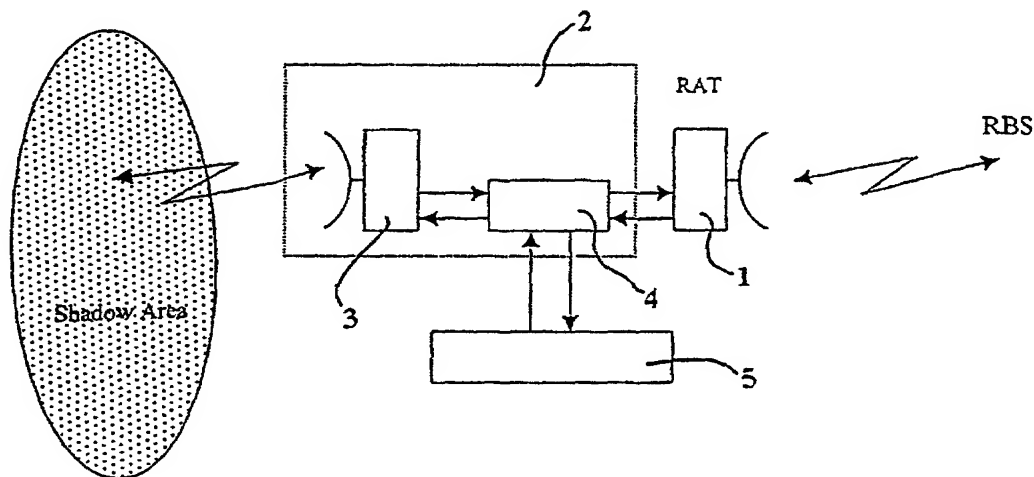
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

- With international search report.
- With amended claims.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ADD-ON RADIO REPEATER FOR TDMA POINT-MULTIPOINT RADIO COMMUNICATION SYSTEMS



(57) Abstract: The functionality of a repeater is given upon request to an ordinary radio access terminal, by addition of an external unit with a new antenna and with suitable co-ordination means, which does not affect the terminal itself.

WO 01/15341 A1

- 1/2 -

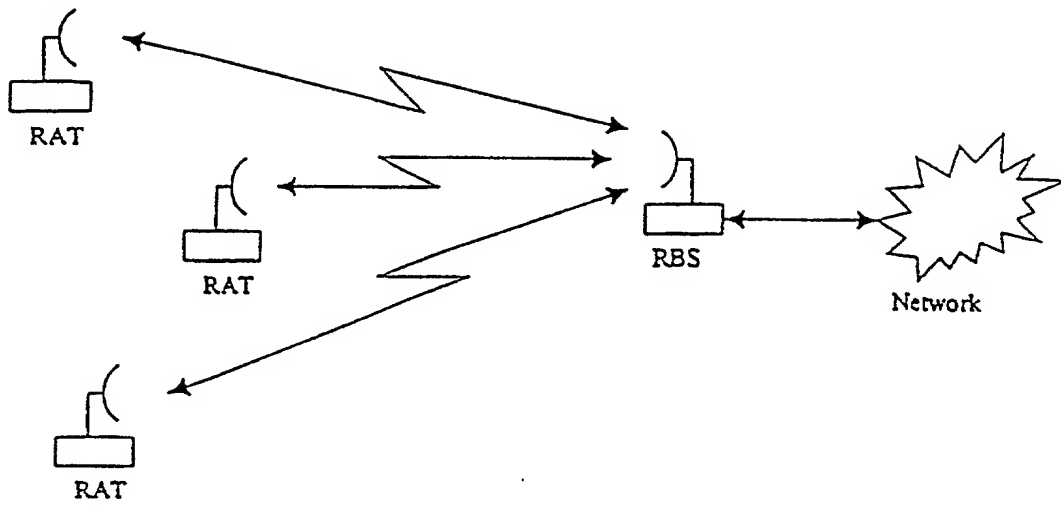


Fig. 1

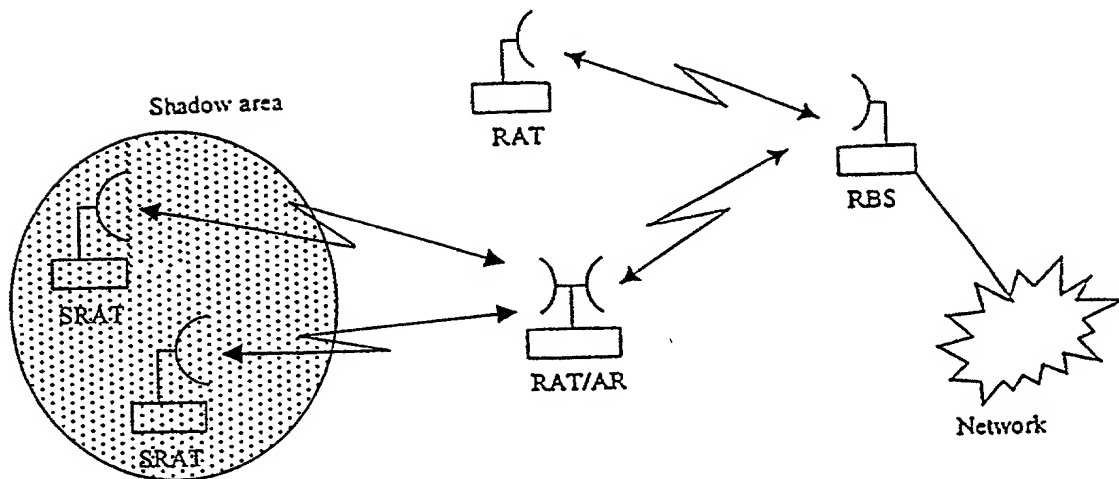


Fig. 2

- 2/2 -

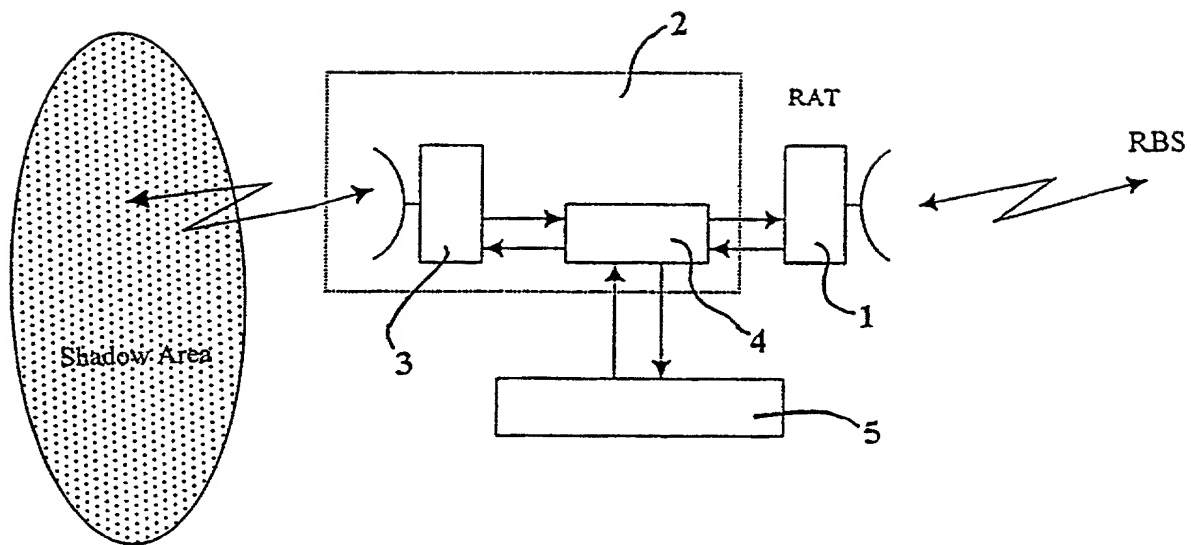


Fig. 3

RULE 63 (37 C.F.R. 1.63)
DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ADD-ON RADIO REPEATER FOR TDMA POINT-MULTIPOINT RADIO COMMUNICATION SYSTEMS

the specification of which (check applicable box(es)):

☐ is attached hereto

☐ was filed on _____

as U.S. Application Serial No. _____

(Atty Dkt. No. _____)

☒ was filed as PCT International application No. _____

PCT/IB00/01088

on 3.08.2000

and (if applicable to U.S. or PCT application) was amended on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with 37 C.F.R. 1.56. I hereby claim foreign priority benefits under 35 U.S.C. 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed or, if no priority is claimed, before the filing date of this application:

Priority Foreign Application(s):

Application Number

Country

Day/Month/Year Filed

9980526.2

EUROPE

19.08.1999

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

Application Number

Date/Month/Year Filed

I hereby claim the benefit under 35 U.S.C. 120/365 of all prior United States and PCT international applications listed above or below and, insofar as the subject matter of each of the claims of this application is not disclosed in such prior applications in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose material information as defined in 37 C.F.R. 1.56 which occurred between the filing date of the prior applications and the national or PCT international filing date of this application:

Prior U.S./PCT Application(s):

Application Serial No.

Day/Month/Year Filed

Status: patented
pending, abandoned

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon. And I hereby appoint **NIXON & VANDERHYE P.C., 1100 North Glebe Rd., 8th Floor, Arlington, VA 22201-4714, telephone number (703) 816-4000** (to whom all communications are to be directed), and the following attorneys thereof (of the same address) individually and collectively my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulting patent: Arthur R. Crawford, 25327; Larry S. Nixon, 25640; Robert A. Vanderhye, 27076; James T. Hosmer, 30184; Robert W. Faris, 31352; Richard G. Besha, 22770; Mark E. Nusbaum, 32348; Michael J. Keenan, 32106; Bryan H. Davidson, 30251; Stanley C. Spooner, 27393; Leonard C. Mitchard, 29009; Duane M. Byers, 33363; Jeffry H. Nelson, 30481; John R. Lastova, 33149; H. Warren Burnam, Jr., 29366; Thomas E. Byrne, 32205; Mary J. Wilson, 32955; J. Scott Davidson, 33489; Alan M. Kagen, 36178; William J. Griffin, 31260; Robert A. Molan, 29834; B. J. Sadoff, 36663; James D. Berquist, 34776; Updeep S. Gill, 37334; Michael J. Shea, 34725; Donald L. Jackson, 41090; Michelle N. Lester, 32331; Frank P. Presta, 19828; Joseph S. Presta, 35329.

- Inventor's Signature: *Andrea Nascimbene* Date: 21-02-2002

Inventor: Andrea (first) Nascimbene (last) MI (citizenship)
Residence: (city) 27020 TORRE D'ISOLA (state/country) Italy ITX Italian ✓
Post Office Address: Via S., Sofia
(Zip Code) 27020 TORRE D'ISOLA - ITALY
- Inventor's Signature: _____ Date: _____

Inventor: _____ (first) _____ (last) MI (citizenship)
Residence: (city) _____ (state/country) _____
Post Office Address: _____
(Zip Code) _____
- Inventor's Signature: _____ Date: _____

Inventor: _____ (first) _____ (last) MI (citizenship)
Residence: (city) _____ (state/country) _____
Post Office Address: _____
(Zip Code) _____

FOR ADDITIONAL INVENTORS, check box ☐ and attach sheet with same information and signature and date for each.